# NOTES ON VELIGERS OF JAPANESE OPISTHOBRANCHS (5)

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*With 7 Text-figures*

Succeeding to the detailed descriptions of veligers of thirteen Japanese opisthobranchs given by the present author in four previous papers (1960–1961), veligers of three more species are described here; they are *Decorifer matushimana* of Fam. Scaphandridae of Ord. Cephalaspidea, *Petarifera punctulata* of Fam. Aplysiidae (=Tethyidae) of Ord. Anaspidea (=Aplysiacea) and *Homoiodoris japonica* of Fam. Doridídae of Ord. Nudibranchia. The first two species were collected at the *Zostera*-zone at Tannowa on the southeastern coast of Ôsaka Bay, while the last one was collected at the intertidal rocky-zone near the same locality.

## *Decorifer matushimana* (NOMURA)

(Figs. 1–2)

This sand-dwelling species is collected commonly in considerable numbers at the muddy sand-zone generally covered with *Zostera nana* at Tannowa during the months from May to July, when many white egg-masses (Fig. 1, A) of this animal can be seen on the muddy sand, most frequently in the period from June to July. The egg-mass consists of about 80 strings gathered to the proximal end of the mass and entangled with one another. Each egg-string is cylindrical, with a 1.5–2 mm diameter and about 25 mm long on an average (the maximum is 80 mm and the minimum is 5 mm). The mass is inserted into the muddy sand by its proximal, rather short tail-like protubrance as in the cases of *Doridium gigliolii* and *Philine japonica* (HAMATANI, 1961). The egg-capsule (Fig. 1, C) is oval in outline and roughly measures 150 to 290 $\mu$ in long diameter. No regular arrangement of capsules can be observed (Fig. 1, B). A single ovum is contained in each capsule and it is about 85 $\mu$ in diameter.

*Early development*: An egg-mass was laid in the laboratory on June 23, 1959, by an animal with a 4 mm long shell collected on June 21 in the field. The water temperature in the laboratory was 26°C. On the next day, embryos in the

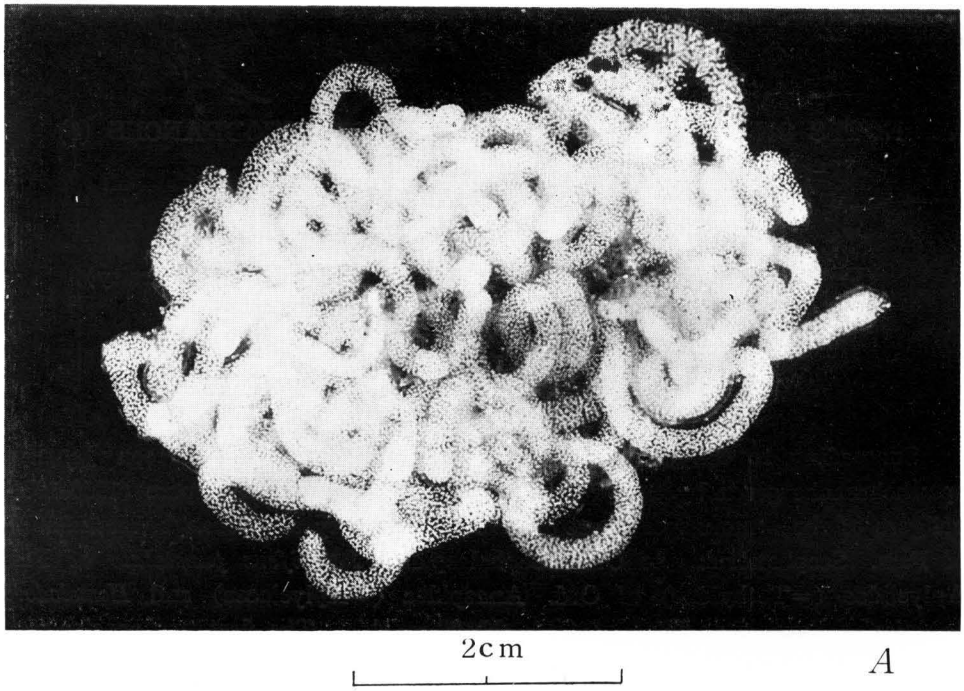



Fig. 1. *Decorifer matushimana* (NOMURA).

A. Egg-mass.
B. A part of the egg-string.
C. Ovum in the egg-capsule.

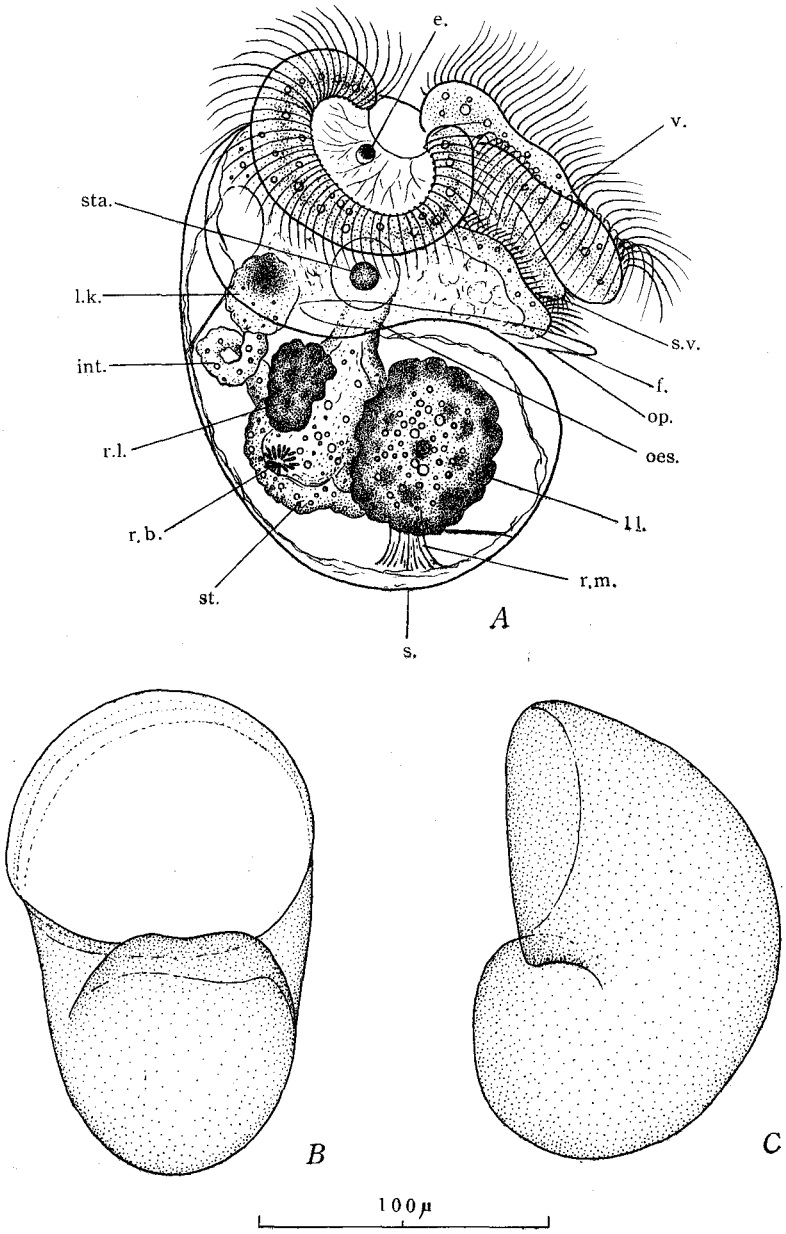



Fig. 2. *Decorifer matushimana* (NOMURA).

A. Newly hatched veliger, from the right side.
B. Larval shell, from the ventral side.
C. The same, from the apex.

Abbreviations : e.···eye, f.···foot, int.···intestine, l. k.···larval kidney, l. l.···left liver, l. sph.···large spherical body, oes.···oesophagus, op.···operculum, r. b.··· rod-like bodies, r. l.···right liver, r. m.···retractor muscle, s.···shell, st.···stomach, sta.···statocyst, s. v.···subvelum, v.···velum.

earliest stage of veliger were found rotating very quickly in the capsule. Veligers swimming freely in the water were seen in the vessel on June 25, thus it took three days from the spawning to the hatching.

*Veligers*: The newly hatched veliger (Fig. 2, A) is somewhat blackish and rather large, measuring 180 $\mu$ in long diameter in a measured specimen. The larval shell (Fig. 2, B and C) is sinistral and has a sculpture consisting of very many minute dots. It is elongate ovoid, and for instance with a 180 $\mu$ long diameter and a 100 $\mu$ short diameter. The operculum is nearly circular and marked with a spiral coiling several times. Both the velum and subvelum are present and both are very faintly yellowish; the former has some refracting granules within it. A pair of black pigmented eyes at the base of velum, statocysts present. The foot is provided with several long cilia on its periphery, which are probably of a sensory function. The mouth is large and devoid of any pigments. The oesophagus and stomach are pigmented darkly on their wall tissue, besides the stomach has many refracting granules and a small patch of rod-like bodies. There are two hepatic lobes as usual, coloured slightly yellow as a whole. The left lobe is larger than the right and has many refracting granules and black pigments in its tissue. The right liver is smaller and black and devoid of any refracting granules. The intestine is slender and colourless, has some refracting granules on the wall and runs in a S-shaped course. Larval kidney is present at the distal end of the intestine on the right side of the body. One half or more of the larval kidney is colourless, while the rest is pigmented in black.

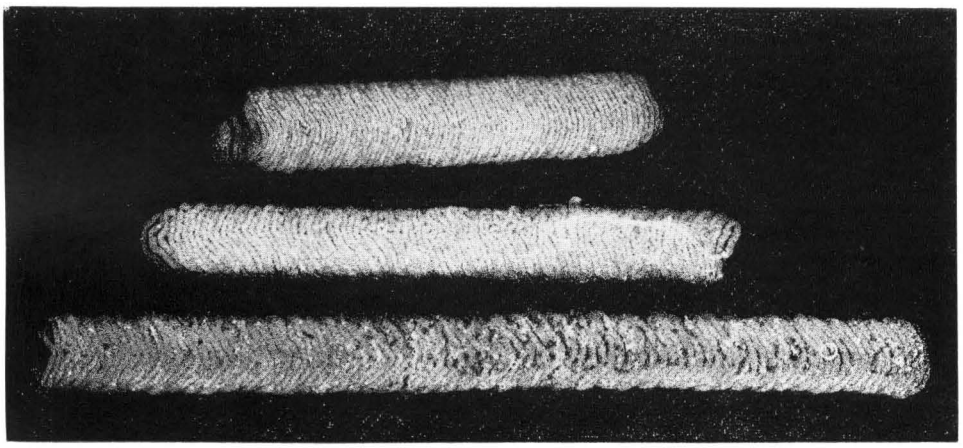
## *Petalifera punctulata* (TAPPARONE-CANEFRI)

(Figs. 3-5)

The animal of this species appears most frequently in considerable numbers on the leaves of *Zostera marina* and sometimes on those of *Z. nana* at Tannowa during the months from May to June. Their spawning also takes place most actively in the same season. Probably this animal lives on the sap of leaves of *Z. marina* and *Z. nana*. The newly spawned egg-mass is yellowish. The whole mass (Fig. 3, A and B) is peculiar in form; it is a flattened and elongate rectangular mass consisting of a long thin string folded so neatly that the mass seems as if it were formed of a series of many short parallel rows. The whole mass is 24 mm long and 4 mm wide on an average. A single ovum (Fig. 4) is contained in each egg-capsule, whose diameter is about 150 $\mu$ along short axis and 190 $\mu$ along long axis. Ova are about 60 $\mu$ in diameter in rather large ones.

*Early development*: The studied egg-mass was collected on July 1, 1962 just after it had been laid on the leaf of *Zostera marina* and further observations were made in the laboratory under the room temperature of 24° to 29°C. A slight sign of embryonic rotation in the capsule was observed on the third day of

development. With the development of embryos, the egg-mass turns to brownish yellow in colour. On the fourth day, the rotatory movement of embryos was almost stopped, as they attained the earliest stage of veliger; this can be



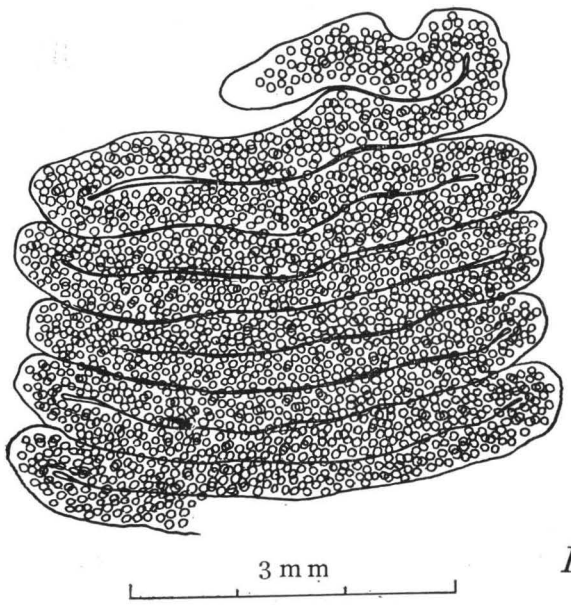




Fig. 3. *Petarifera punctulata* (TAPPARONE-CANEFRI).
A. Egg-masses.
B. A part of the egg-string.

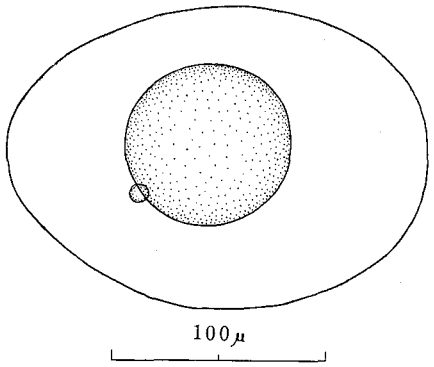



Fig. 4. *Petarifera punctulata* (TAPPARONE-CANEFRI). Ovum in the capsule.

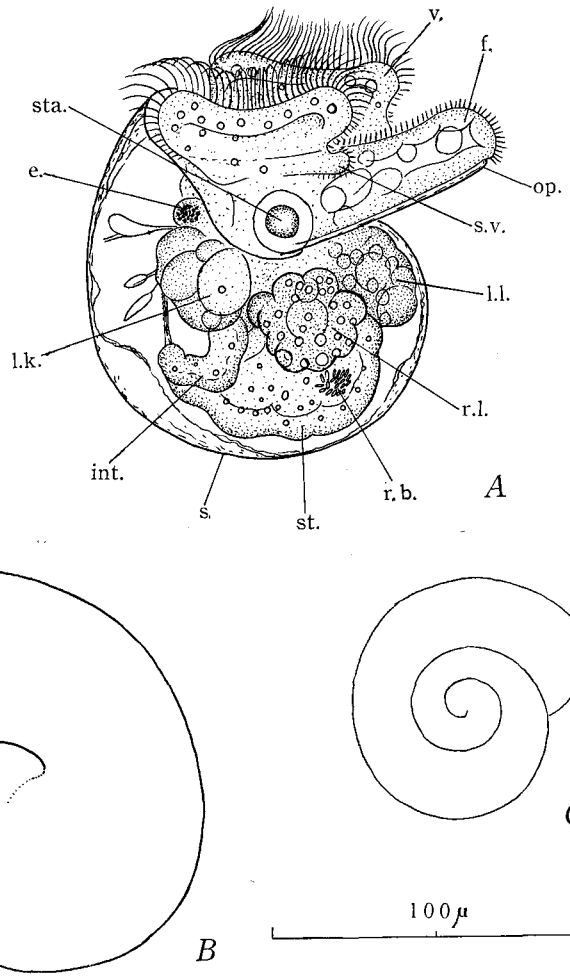



Fig. 5. *Petarifera punctulata* (TAPPARONE-CANEFRI)

A. Newly hatched veliger, from the right side.
B. Larval shell, from the apex.
C. Operculum.
(For abbreviations see Fig. 2)

ascertained by the appearance of statocysts, shell and operculum, and ciliated velum containing some refracting granules. On the fifth day, embryos seem to reach the last veliger stage and the hatching out of free swimming larvae began on the sixth day and continued to the next day.

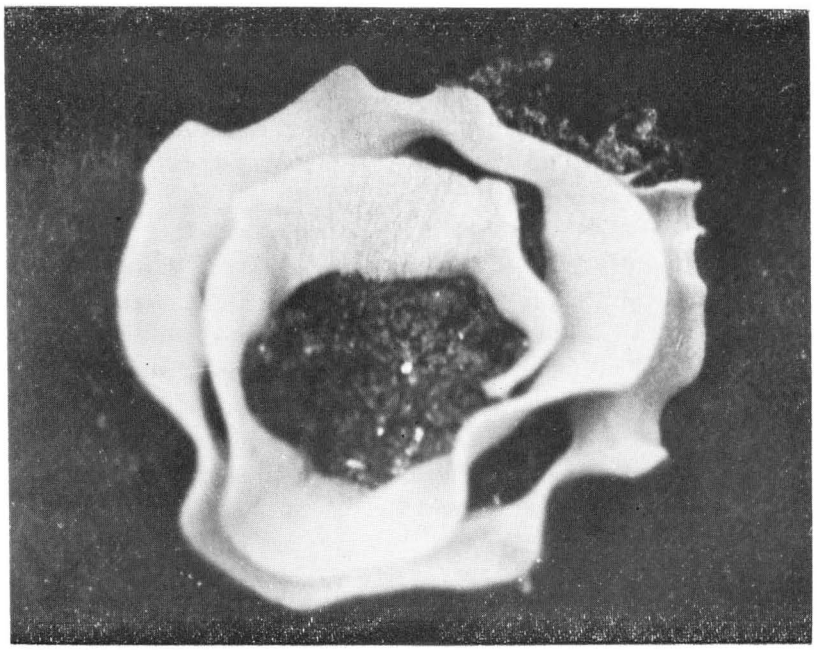
*Veligers*: The whole body of newly hatched veliger (Fig. 5, A) is roundish in form and faintly yellowish in colour. The body is 126$\mu$ in long diameter in an examined specimen. The larval shell (Fig. 5, B) is sinistral, transparent and colourless. It has a plain sculpture consisting of very small dots, long diameter is 112$\mu$ (133$\mu$ at the maximum and 97$\mu$ at the minimum), and short diameter is 97$\mu$ (108$\mu$ at the maximum and 79$\mu$ at the minimum) on an average. The operculum (Fig. 5, C) is nearly circular, about 70$\mu$ in diameter, and has a spiral sculpture coiling about 3 times. The ciliated velum contains some refracting granules, the subvelum is formed distinctly. A pair of statocysts are well marked as in veligers of other opisthobranchs, but eyes are quite absent. An organ of unknown nature is formed just behind the anus on the right side of the body and it contains several colourless granules; maybe this is a rudimentary eye. Usually the foot protrudes out beyond the operculum edge. The stomach is rather large, some rod-like bodies are seen on the right side of stomach. The stomach and intestine have some refracting granules in the wall tissue. Two hepatic lobes are found connected with the stomach. The left lobe is larger than the right and coloured yellow; the right one is slightly yellowish or quite colourless; both contain many large refracting granules. There are some roundish organs situated near the end of the intestine on the right side of the body and faintly coloured yellowish, one of them may probably be the larval kidney.

## *Homoiodoris japonica* BERGH

(Figs. 6–7)

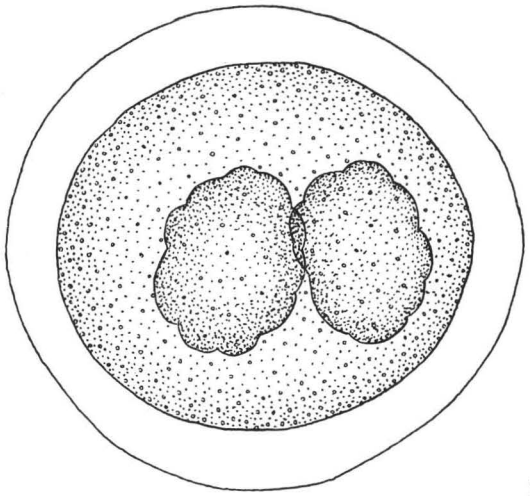
This species is met with commonly on the shore of Osaka Bay during the spring season (BABA, HAMATANI and HISAI, 1956). The examined egg-mass (Fig. 6, A) in this paper, together with several animals with a body length of 45 mm on an average and some egg-masses, was collected on June 30, 1962 at the intertidal rocky zone of Tannowa. The egg-mass is ribbon-like and coiled sinistrally 2 times and a little more and it measures about 40 mm in diameter of the outermost coil. The ribbon is 10 to 11 mm in width, coloured chrome yellow, and with a waved free border (see also BABA, HAMATANI and HISAI, 1956). Usually each egg-capsule contains 2 to 4 ova (rarely 1 or up to 8) (Fig. 6, B). The capsule is nearly spherical, its diameter being very variable in the range from 190 to 300$\mu$. The ovum measures about 80$\mu$ in diameter on an average.

*Early development*: The above-mentioned egg-mass was spawned in the field under the water temperature of 21°C. On the third day of the development



2cm

A



B

100 μ

Fig. 6. *Homoiodoris japonica* BERGH,

A. Egg-mass (Original photo taken at Tannowa on June 30, 1962).
B. Egg-capsule with two ova.

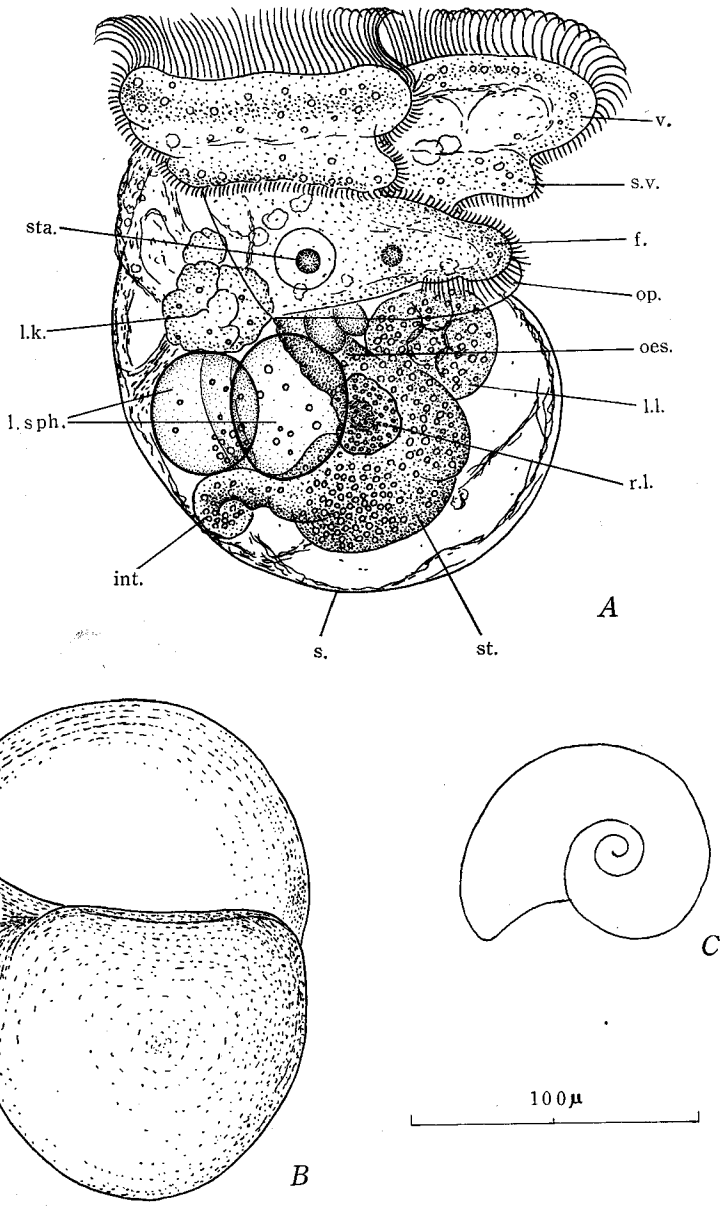



Fig. 7. *Homoiodoris japonica* BERGH.

A. Newly hatched veliger, from the right side.
B. Larval shell, from the ventral side.
C. Operculum.
(For abbreviations see Fig. 2)

embryos began to move slightly, as they were probably in the trochophore stage at that time. On the next day they attained the earliest stage of veliger, when the egg-mass was tinted faintly brownish. Veligers hatched out from the capsule were first observed six days after the spawning. During this observations the room temperature fluctuated in the range from 24° to 29°C.

*Veligers*: The newly hatched veligers (Fig. 7, A) are lightly brownish and roundish in outline. They are rather large, about 190$\mu$ in long diameter in an examined specimen. The shell (Fig. 7, B) is sinistral, ovoid in shape and with a long diameter of 162$\mu$ in an examined specimen. It is colourless and has a sculpture consisting of a number of minute dots covering the whole surface. The operculum (Fig. 7, C) is roughly circular in shape, 72×90$\mu$ in size in an examined specimen and has a sculpture of a spiral line coiling about 3 times. The velum and subvelum are present, and both velar organs contain no pigments but refracting granules; the cilia on the former are rather short but strong, while those on the latter are very slender. Statocysts well marked and eyes entirely absent. The ciliated foot does not contain any special large cells nor protrude beyond the operculum edge. The oesophagus is rather stout and unpigmented. The stomach is furnished densely with a number of non-refracting granules in the tissue, therefore it is rather difficult to discern the ciliary movement on the inner wall and the rod-like bodies in the tissue, although the latter forms a small area certainly. There are two hepatic lobes, of which the left one is larger than the right as usual. Both lobes are slightly brownish in colour and contain many small granules. The slender intestine is S-shaped and leads to the larval kidney which is quite colourless and transparent. On the right side of the body, there are two large spherical and colourless bodies seen very distinctly near the intestine. The nature of these bodies is quite unknown in this species, too, as in the cases described by the present author on *Hargerda rubicunda* (1960), *Doriopsis viridis* and *D. aurantiaca* (1961).

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